Muelleria 14:17 (2000)

The lichens of *Nothofagus cunninghamii*-dominated rainforests and *Acacia melanoxylon*-dominated forests in the Otways, Victoria.

Sharon Ford, Maria Gibson and Geoff Duke

Biological and Chemical Sciences
Deakin University, Rusden Campus
662 Blackburn Road, Clayton, VIC, 3168.

Abstract

Lichens occurring in rainforests dominated by *Nothofagus cunninghamii* (Hook.) Oerst. and in forests dominated by *Acacia melanoxylon* R. Br. were examined in the Otway Ranges, southwest Victoria. A total of 110 species were recorded, 93 occurred in *N. cunninghamii* rainforests and 67 in *A. melanoxylon* forests. Fifty of these species were common to both forest types. In total, 17 lichen species are newly reported for Victoria.

Introduction

The Otway Ranges are approximately 200 km southwest of Melbourne, Victoria (D.N.R.E. 1996). Calder (1990) described the region as an island, with Bass Strait to the south and the vast basalt plains to the north effectively isolating the area. There are no comparable regions closer than 400 km away (Calder 1990). The Otway Ranges extend approximately 80 km, and contain a wide variety of forest types including examples of heathlands, coastal vegetation, wet mountain forests and cool temperate rainforest (D.N.R.E. 1996).

The Otways have a temperate climate. Most rain falls between May and September, with the mean annual rainfall varying between 1750 to 2000 mm (Brinkman & Farrell 1990). Mean maximum temperatures range from 20°C on the coast to 27°C inland in the warmest months, January and February (Brinkman & Farrell 1990). The coldest months see average minimums of 3 to 4°C (Brinkman & Farrell 1990).

There is little published information on the lichen flora of the Otways region, although historically the region has attracted some attention from past collectors, for example, R. Filson in 1963–4, J.H. Willis in 1955 and 1963 and A.C. Beauglehole in 1953. Indeed, there are comparatively few studies on lichens in Victorian rainforests. Louwhoff (1995) examined the lichen floristics of Mt. Donna Buang Scenic Reserve, which included some small pockets of rainforest, and Wedin (1995), in his review of the lichen family Sphaerophoraceae in the southern hemisphere, examined the genera *Bunodophoron* A. Massal. and *Lefidium* Wedin from Victorian rainforest. Recently, a revision of the lichen genus *Usnea* Dill. *ex* Adans. included species found in rainforests in Victoria (Stevens 1999).

Cool temperate rainforests are cited as one of the most important vegetation communities in the Otways (D.N.R.E. 1996) and are dominated by *Nothofagus cunninghamii* (Hook.) Oerst. Many Victorian rainforests are co-dominated by *N. cunninghamii* and *Atherosperma moschatum* Labill., however, the latter species appears to be absent from the Otways (Busby & Brown 1994; Peel 1999), and is apparently being replaced by *Hedycarya angustifolia* A. Cunn. for the most part, but also in part by *Pittosporum bicolor* Hook., *Olearia argophylla* (Labill.) Benth. and *Acacia melanoxylon* R.Br. *Dicksonia antarctica* Labill. is always present as an understorey along with ground ferns such as *Blechnum wattsii* Tindale and/or *Polystichum proliferum* (R. Br.) Presl. The Otways *N. cunninghamii*-dominated rainforests are classified as "callidendrous rainforest" (after Jarman *et al.* 1991) or "Otways cool temperate rainforest" (after Peel 1999).

Acacia melanoxylon is a fast growing species (Floyd 1989) that forms almost pure stands in the Otways. The species is dominant in areas of past disturbance and frequent fire, which tends to favor the establishment of *Acacia* species (Busby & Brown 1994). Physiognomically, these almost pure stands of *A. melanoxylon* might be classified as either callidendrous or thamnic rainforests (after Jarman *et al.* 1991) as they have a structural resemblance to true rainforest (closed canopies, multi-strata vegetation, ferny understorey and high dominance of epiphytes). However, they are floristically not considered rainforests unless there is significant co-dominance by *N. cunninghamii* or other recognised rainforest trees (D.C.F.L. 1987; Peel 1999). These forests are considered 'tall open forests' by Ashton and Attiwill (1994). Other associated species include *Nematolepis squamea* (Labill.) Paul. G. Wilson, *Coprosma quadrifida* (Labill.) Robinson, *Olearia argophylla* and *Pomaderris aspera* Sieb. *ex* DC. *Dicksonia antarctica* and *B. wattsii* are often present as understorey species.

This paper examines some of the similarities and differences in lichen composition between rainforests dominated by *Nothofagus cunninghamii* (Hook.) Oerst. and the structurally similar tall open forests dominated by *Acacia melanoxylon* R. Br. in the Otways, Victoria. The study forms part of a much larger, ongoing investigation examining the lichen communities of cool temperate rainforest throughout Victoria.

Methods

A total of 20 randomly selected quadrats were sampled, 10 in rainforests dominated by *Nothofagus cunninghamii* and 10 in forests dominated by *Acacia melanoxylon*.

Due to the very limited extent of rainforest in Victoria, the more traditional map-grid method of randomly selecting sites was not appropriate. Victorian rainforests occur as small pockets in moist gullies and along creeks and rivers (Busby & Brown 1994; D.C.F.L. 1987). Those of the Otways are no exception. Methods using larger scale grids would certainly miss most of these pockets. Instead, potential sites of both *N. cunninghamii*-dominated rainforest and, for consistency, *A. melanoxylon*-dominated forests were located through study of maps and by field surveys. Appropriate sites were listed and a computer-generated random number table was used to select actual study sites.

Quadrats measuring 20m × 20m (after Louwhoff 1992, 1995) were placed in the approximate centre of the selected forest pockets, where edge effect was considered minimal.

Five trees of each species present in four size classes (Table 1) were sampled where they were present in the quadrat. Different size classes of trees represent different ages and, hence, have varying bark characteristics. This factor is known to influence lichen floristics (Adams & Risser 1971; Griffin & Conran 1994; Kantvilas 1990), so each size class must be examined to obtain an accurate representation of the lichen flora present in the forest pocket under investigation. An analysis of lichen variation between size classes was not undertaken as this would require a much larger sample size than that obtained.

Lichen species and percent cover-abundance were recorded up to a height of 2 metres,

Table 1. Size classes used for the major tree species in *Nothofagus cunninghamii*-dominated rainforests and *Acacia melanoxylon*-dominated forests in Victoria.

Size class	Radius at chest height *(cm)*
Small	<5
Medium	5–10
Large	10–20
Extra Large	20+

this being the practical limit of accessibility. Recently fallen branches and sticks were collected from the forest floor in each quadrat as a representation of what was present in the canopy (Jarman & Kantvilas 1995a).

Nomenclature follows Filson (1996), *Flora of Australia* Volumes 54 and 55 (1992 and 1994 respectively), Wedin (1995) for the genera *Bunodophoron* and *Lefidium* and Stevens (1999) for the genus *Usnea*. Distinct lichen species not able to be matched against available literature were assigned "sp. 1" etc.

A 2-dimensional Non-metric Multidimensional Scaling (NMDS) ordination for the average cover of each lichen species in the 20 quadrats was performed using CLUSTER, MDS and CONPLOT in the statistical package PRIMER (Plymouth Routines in Multivariate Ecological Research). NMDS constructs a configuration of the samples, which attempts to satisfy all the conditions imposed by the rank similarity matrix (Clarke & Warwick 1994). Bray-Curtis similarity matrix was used, which is appropriate for delineating groups of sites with distinct community structure and patterns of abundance (Clarke & Warwick 1994). The data were given 4th root transformation in order to evenly weight both the dominant species and the rare species (Clarke & Warwick 1994). A dendrogram results from the CLUSTER option of PRIMER, and is presented as further explanation of the relationships between the similarities of quadrats.

Results

In total, 495 trees, representing 10 different vascular species, were examined (Table 2). A total of 110 lichen species were recorded, 93 from rainforests dominated by *N. cunninghamii* and 67 from forests dominated by *A. melanoxylon*. Fifty species were common to both forest types (Appendix I).

Of the 93 lichen species occurring in *N. cunninghamii* rainforests, 66 were recorded in the canopy and 38 in the lower trunk region. Thirteen species were found in both the canopy and lower trunk regions (Fig. 1). Similarly, the canopy of *A. melanoxylon* forests had a higher species richness than the lower trunk region with 43 and 35 species respectively and 12 species common to both. The lower trunk region of both forest types appeared to be comparable in terms of lichen species richness over the 20 quadrats examined.

Table 2. Number of trees of each species sampled.

Tree species	Total sampled	*Nothofagus* rainforest	*Acacia* forest
Nothofagus cunninghamii	113	102	11
Hedycarya angustifolia	98	45	53
Acacia melanoxylon	91	7	84
Dicksonia antarctica	68	43	25
Coprosma quadrifida	53	19	34
Pittosporum bicolor	27	11	16
Olearia argophylla	19	9	10
Nematolepis squamea	13	0	13
Pomaderris aspera	11	0	11
Cyathea australis	2	0	2
Total:	**495**	**236**	**259**

Figure 1. Lichen species-richness of the lower trunk and canopy, showing overlap of species common to both.

In total, 30 families were represented in the forests studied, 29 occurred in *N. cunninghamii* rainforests and 24 occurred in *A. melanoxylon* forests. All families recorded in *A. melanoxylon* forests were found in *N. cunninghamii* rainforests, with the exception of the Ramalinaceae. Six families were exclusive to *N. cunninghamii* rainforest: Arthoniaceae, Chrysothricaceae, Coccotremataceae, Lecanactidaceae, Nephromataceae and Teloschistaceae. In all cases, representatives from these families were not recorded frequently in the study areas, therefore, there may be insufficient data from which to draw conclusions.

Ten families were well represented in *N. cunninghamii* rainforests, with four or more species being recorded for each (Table 3). In *A. melanoxylon* forests, six families were recorded with more than four species each. In many cases, these families were represented by only one genus, for example, the Thelotremataceae by the genus *Thelotrema* Ach., the Pertusariaceae by *Pertusaria* DC. and the Usneaceae by *Usnea* Dill. ex Adans. The families Cladoniaceae, Lobariaceae, Pertusariaceae, Sphaerophoraceae and Thelotremataceae appear to be important groups for *N. cunninghamii* rainforests as they have large numbers of representative species, and were rarely recorded in *A. melanoxylon* forests (Table 3). Similarly the Collemataceae appears to be an important family in the *A. melanoxylon* forests.

Table 3. Commonly represented families in *Nothofagus cunninghamii*- dominated rainforests and *Acacia melanoxylon*-dominated forests in the Otways.

Family	*Nothofagus*-dominated		*Acacia*-dominated	
	No. Genera	*No. Species*	*No. Genera*	*No. Species*
Cladoniaceae	2	4		
Collemataceae			2	4
Hypogymniaceae	2	8	2	5
Lecideaceae	4	5	3	5
Lobariaceae	1	7		
Pannariaceae	1	5	2	4
Parmeliaceae	6	12	5	8
Pertusariaceae	1	6		
Sphaerophoraceae	2	6		
Thelotremataceae	1	4		
Usneaceae	1	5	1	7

Canopy species were included in the above figures, however, due to the haphazard nature of collecting lichens from the canopy, these data were not included in the following analyses. It is possible to indicate which species are present in the canopy, but the absence of species could just be a reflection of the sampling procedure.

The number of species per quadrat ranged from as low as two species in *A. melanoxylon* forest, and up to 20 species in *N. cunninghamii* rainforest (Fig. 2). On average, *N. cunninghamii* rainforests supported a higher species richness (mean of 12.8 species) than *A. melanoxylon* forests (mean of 8.7 species), however, an independent samples *t* test revealed that this difference was not significant ($p = 0.085$).

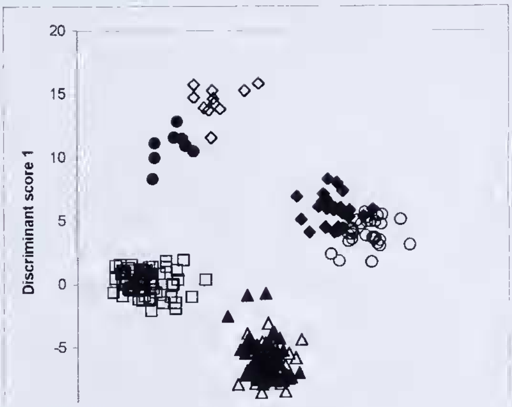

Figure 2. Species richness per quadrat in the two forest types. A *t* test on the difference between the means was not significant with $p = 0.085$.

On consideration of the common species from the two forest types (that is species occurring in six or more of the ten quadrats), there appears to be a distinct flora for each forest type, with two species, *Lepraria* sp. and *Thelotrema lepadinum* (Ach.) Ach. being common to both (Table 4). Three species, *Bunodophoron australe* (Laurer) A. Massal, *Metus conglomeratus* (F. Wilson) D.J. Galloway & P. James and *Pyrenula nitida* (Weig.)

Table 4. Comparison of common species (occurring in six or more of the ten quadrats) in the lower trunk region of *Nothofagus cunninghamii*-dominated rainforests and *Acacia melanoxylon*-dominated forests.

***Nothofagus cunninghamii* rainforest**	***Acacia melanoxylon* forest**
Bunodophoron australe	
Bunodophoron murrayi	
Cladia aggregata	
Metus conglomeratus	
Pseudocyphellaria dissimilis	
Pseudocyphellaria glabra	
Pyrenula nitida	
Thelotrema subdenticulatum	
Lepraria sp.	*Lepraria* sp.
Thelotrema lepadinum	*Thelotrema lepadinum*
	Bacidia buchananii
	Leptogium victorianum
10 species	**4 species**

Table 5. Comparison of common species (occurring in six or more of the ten quadrats) from the canopy of *Nothofagus cunninghamii*- dominated rainforests and *Acacia melanoxylon*-dominated forests.

***Nothofagus cunninghamii* rainforest**	***Acacia melanoxylon* forest**
Coccotrema cucurbitula	
Menegazzia myriotrema	
Menegazzia sp. 1	
Pertusaria novaezelandiae	
Sarrameana tasmanica	
Thelotrema sp. B	
Maronea constans	*Maronea constans*
Megalaria grossa	*Megalaria grossa*
Parmelia tenuirima	*Parmelia tenuirima*
Thelotrema lepadinum	*Thelotrema lepadinum*
	Hypogymnia mundata
	Normandina pulchella
	Parmelina quercina
	Pertusaria gibberosa
	Pyrrhospora laeta
	Tephromela atra
10 species	**11 species**

Ach., were not recorded in *A. melanoxylon* forests. In the canopy (Table 5), differences in species composition also can be seen, with four species, *Maronea constans* (Nyl.) Hepp., *Megalaria grossa* (Pers. ex. Nyl.) Hafellner, *Parmelia tenuirima* Hook. f. & Taylor and *T. lepadinum* being common to both forest types.

A NMDS ordination configuration of average cover abundance of lichen species in each quadrat revealed two groups of quadrats with 2 outlier quadrats (Fig. 3). The dotted lines enclose groups of sites with a similarity of 32 percent, as shown in the dendrogram (Fig. 4). There appeared to be a lichen flora that was characteristic of *N. cunninghamii* rainforest and a lichen flora characteristic of *A. melanoxylon* forest as both forests clustered separately. The exceptions were quadrat numbers 07A and 02A which showed a high similarity to the quadrats dominated by *N. cunninghamii*. The dendrogram (Fig. 4) clustered these two quadrats with the *N. cunninghamii* forests at 55 and 50 percent similarity, respectively. Quadrat 07A was dominated by *A. melanoxylon*, but had a subdominant canopy of *N. cunninghamii*. Quadrat 02A appeared to have a fairly common collection of lichen species, with no rare or unusual species, which may contribute to its similarity to *N. cunninghamii* forests. Indeed, this quadrat may be clustered arbitrarily with the other *A. melanoxylon* forests on the NMDS (Fig. 3). The outliers 09A and 10N recorded the lowest number of species for their respective forest types. A NMDS ordination was also done for presence/absence data and lichen cover per area of tree sampled. Results were essentially the same with only minor variations in distance configuration.

New Records

All lichen species have previously been found in Australia, but a total of 17 new records for Victoria were recorded during this study (Table 6). Of these, *Bunodophoron murrayi* (Ohlsson) Wedin, *Coccotrema cucurbitula* (Mont.) Mull. Arg., *Graphis insidiosa* (C.

Figure 3. Mean cover of lichen species. NMDS of 20 sites based on 4th root transformed abundances and Bray-Curtis similarities (Stress = 0.14). N = quadrats dominated by *Nothofagus cunninghamii*; A = quadrats dominated by *Acacia melanoxylon*.

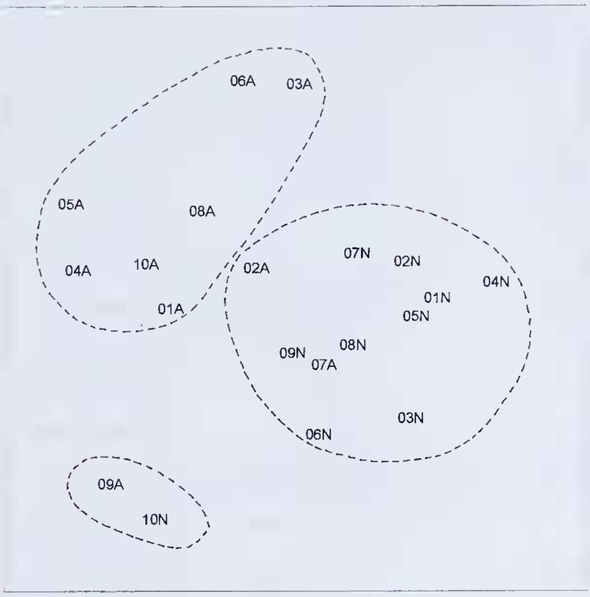

Figure 4. Mean cover of lichen species. Dendrogram of 20 quadrats using average clustering from Bray-Curtis similarities on 4th root transformed cover abundance data.

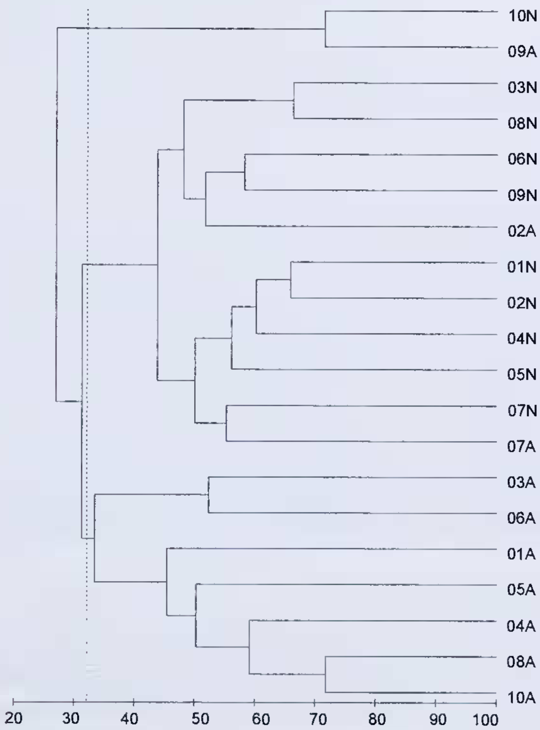

Table 6. Lichen species newly recorded for Victoria.

Species	Herbarium No.*	Spp. description ref.
Bacidia laurocerasi	MEL; SF 120	Galloway 1985
Bunodophoron murrayi	MEL *2085466*; SF110	Galloway 1985; Wedin 1995 (as *Sphaerophorus murrayi*)
Cliostomum griffithii	MEL *2085462*; SF108/109	Galloway 1985
Coccotrema cucurbitula	MEL *2085468*	Galloway 1985; Kantvilas 1990a
Graphis insidiosa	MEL *2085463*; SF119	Galloway 1985; Kantvilas & James 1991
Lecidea immarginata	MEL, SF123	Kantvilas & James 1991
Lepraria lobificans	MEL *2085461*; SF142/157	Kantvilas & James 1991
Menegazzia eperforata	MEL *2085469*; SF158	Flora of Australia 1992
Micarea prasina	MEL *2085467*	Coppins 1983
Parmelia protosulcata	MEL *2085464*	Flora of Australia 1994
Parmotrema robustum	MEL *2060624*; SF116 (from W. Prom) Flora of Australia 1994	
Phaeographis exaltata	MEL *2085465*; SF117/118	Galloway 1985; Kantvilas & James 1991
Phlyctis subuncinata	MEL *2085470*	Galloway 1985; Kantvilas & James 1991
Sarrameana albidoplumbea	MEL *2085471*	Kantvilas & Vezda 1995
Usnea oncodes	MEL *2085460*; SF144/150	Stevens 1999
Usnea pycnoclada	SF149	Stevens 1999
Usnea xanthopoga	MEL *2085472*; SF151	Stevens 1999

* MEL = Melbourne Herbarium, Royal Botanic Gardens, SouthYarra
SF = Personal herbarium of Sharon Ford

Knight & Mitt.) Hook. f., *Lecidea immarginata* R. Br. ex Cromb., *Menegazzia eperforata* P. James & D.J. Galloway, *Micarea prasina* Fr., *Parmelia protosulcata* Hale, *Usnea pycnoclada* Vainio and *U. xanthopoga* Nyl. are not surprising additions to Victoria's lichen flora as they are currently known from Tasmania and New South Wales. These records simply fill in the previous disjunct distribution. *Cliostomum griffithii* (Sm.) Coppins, *Lepraria lobificans* Nyl., *Phaeographis exaltata* (Mont. & v.d. Bosch) Mull. Arg., *Phlyctis subuncinata* Stirton, *Sarrameana albidoplumbea* (Hook. f. & Taylor) Farkas and *Usnea oncodes* Stirton are new for the mainland and *Bacidia laurocerasi* (Delise *ex* Duby) Zahlbr. and *Parmotrema robustum* (Degel.) Hale have their southern most record in the Otways. *Menegazzia eperforata* and *P. robustum* were recently reported from the rainforests at Wilsons Promontory by one of the authors (Ford & May, 1998), however, no formal publication of these records was made at the time.

Discussion

Currently, the number of macrolichen species in Tasmanian rainforests stands at 355 species, 200 macrolichens and 155 crustose lichens (Jarman & Kantvilas 1995a). The total number of lichen species currently known for Victorian rainforests is 149 species, with 94 macrolichens and 54 microlichens (compiled from Ford unpubl.; Ford & May 1998; Louwhoff 1995). Victorian rainforest lichen figures are projected to increase considerably as more work is completed. The lichens of Tasmanian rainforests and wet sclerophyll forests have received much attention in the past decade (Brown *et al.* 1994; Jarman & Kantvilas 1994; Jarman & Kantvilas 1995a; Jarman & Kantvilas 1995b; Kantvilas 1990; Kantvilas 1995; Kantvilas & James 1991; Kantvilas & Jarman 1991; Kantvilas & Jarman 1993), allowing for comparison of the lichen flora of the Otways with published lists for Tasmanian forests.

A large proportion of the lichens found during this study may be considered "ubiquitous wet forest" species (Kantvilas & Jarman 1993). Of the 31 lichen species listed as ubiquitous by Kantvilas & Jarman (1993, p. 219), 19 were recorded from the Otways. Of these, all 19 species were found in *N. cunninghamii* rainforest, and 14 species were found in *A. melanoxylon* forest. Common examples include: *Bacidia buchananii* (Stirt.) Hellb., *Cladia aggregata* (Sw.) Nyl., *Parmelia tenuirima* Hook f. & Taylor, *Psoroma microphyllizans* (Nyl.) D.J. Galloway and *Pseudocyphellaria glabra* (Hook f. & Taylor) C.W. Dodge. Of the 26 "typical rainforest species" listed by Jarman and Kantvilas (1993), seven were found in this study. All seven species were recorded in *N. cunninghamii* rainforest, and four species (*Sarrameana albidoplumbea* (Hook f. & Taylor) Farkas (syn. *Bacidia albidoplumbea*), *Micarea prasina* Fr., *Thelotrema lepadinum* (Ach.) Ach. and *Usnea oncodes* Stirton) were found in the tall open forests dominated by *A. melanoxylon*. Seven out of 34 "non-rainforest species" (Kantvilas & Jarman 1993), or species that generally characterise sclerophyll forest, were also found, five in *N. cunninghamii* rainforest and 6 in *A. melanoxylon* forest.

Many of the lichens recorded in this study are considered "widespread" lichens for the three Tasmanian rainforest suballiances: callindendrous, thamnic and implicate (Jarman & Kantvilas 1995a; refer to Jarman *et al.* 1991 for rainforest descriptions). Of the 44 widespread rainforest lichens listed (Jarman & Kantvilas 1995a), 28 were found in the Otways. Twenty-five of these species were recorded from *N. cunninghamii* rainforest and 15 species from *A. melanoxylon* forest. Of the 18 species listed as being restricted to callidendrous rainforest, five species were recorded in *A. melanoxylon* forests. These were *S. albidoplumbea*, *Bunodophoron murrayi*, *Menegazzia myriotrema*, *P. tenuirima* and *Pseudocyphellaria dissimilis* (Nyl.) D.J. Galloway & P. James. These five species and an additional three species (*Arthothelium interveniens* (Nyl.) Zahlbr., *Bunodophoron ramuliferum* (I.M. Lamb) Wedin and *Lecanactis abietina* (Ach.) Korb.) were found in *N. cunninghamii* rainforest.

It was interesting to note that some typical rainforest lichen species are recorded in *A. melanoxylon*-dominated tall open forest. The observed structural similarities between *N. cunninghamii* rainforests and *A. melanoxylon* forests may lead to microclimatic correlations, explaining some of the similarity in lichen species composition. The presence of *N. cunninghamii* as a component of the canopy in some *A. melanoxylon* dominated forests also may be a contributing factor. Just as different forms of rainforest have a ubiquitous group of lichen species and a number that are characteristic of each forest type (Jarman & Kantvilas 1995a), the results suggest that *N. cunninghamii* rainforests and *A. melanoxylon* forests also have both a distinct flora and a shared flora. Seventy-nine percent of lichen families were represented in both forest types, while 45 percent of species were common to both. The remainder are divided, 39 percent of lichen species are confined to *N. cunninghamii* rainforest and 15 percent of species confined to *A. melanoxylon* forests.

In studies comparing rainforest to sclerophyll forest, rainforests consistently recorded higher species richness (Jarman & Kantvilas 1994; Kantvilas & Jarman 1993; Louwhoff 1995). However, the differences may be minimal, for example Kantvilas & Jarman (1993) recorded 79 species in disturbed rainforest in Tasmania and 72 species in surrounding sclerophyll forest, a difference of seven species. Jarman and Kantvilas (1994) recorded 72 and 78 lichen species in two types of *Eucalyptus*-dominated sclerophyll forest, compared to 83 species in rainforest, with a minimum difference of 5 species. Louwhoff (1995) recorded 56 species in *N. cunninghamii*-dominated rainforest and 42 species in *Eucalyptus*-dominated sclerophyll forests at Mt. Donna Buang Scenic Reserve, Victoria, a difference of 14 species.

A considerably greater difference in species number was found between the two forest types considered here, when compared with similar studies comparing forest types in south-eastern Australia. Overall (canopy inclusive), a difference of 26 species was found, with higher species richness recorded in *N. cunninghamii* rainforests (93 spp. compared to 67 spp. in *A. melanoxylon* forests).

Lichenologically, cool temperate rainforests are recognised as one of the most floristically diverse forest types (Jarman & Kantvilas 1995a; 1994; Kantvilas 1990). The generally low species richness in *A. melanoxylon* tall open forests may be an indication that these forests are quite distinct from *N. cunninghamii*-dominated rainforest despite their structural similarity. However, they share a high proportion of lichen species with the *N. cunninghamii* rainforests, some of which are considered true rainforest lichen species.

Acknowledgments

The authors would like to thank Deakin University (Rusden Campus), Barwon Water and the Department of Natural Resources and Environment (Apollo Bay Office) for their continuing support during this research.

Thank you also to Gintaras Kantvilas, Jack Elix, Nell Stevens, Patrick McCarthy and Alan Archer for their kind aid in the identification and confirmation of certain species.

This paper was presented, in part, at the Australasian Lichenologists Conference held in Dunedin, New Zealand, 15-19 November 1998.

References

Adams, D. B. and Risser, P. G. (1971). Some factors influencing the frequency of bark lichens in North Central Oklahoma. *American Journal of Botany* **58**: 752–757.

Ashton, D.H. and Attiwill, P.M. (1994). Tall open-forests. In 'Australian Vegetation'. (Ed R.H. Groves) pp. 157–196. (Cambridge University Press: Melbourne).

Brinkmann, R. and Farrell, S. (1990). *Statement of resources, uses and values for the Otways Forest Management Area.* Department of Conservation and Environment, Victoria.

Brown, M. J., Jarman, S. J. and Kantvilas, G. (1994). Conservation and reservation of non-vascular plants in Tasmania, with special reference to lichens. *Biodiversity and Conservation* **3**: 263–278.

Busby, J. R. and Brown, M. J. (1994). Southern Rainforests. In 'Australian Vegetation'. (Ed R.H. Groves) pp. 131–156. (Cambridge University Press: Melbourne).

Calder, J. (1990). *Parks: Victoria's National and State Parks.* Victorian National Parks Association, Canterbury Press Pty. Ltd., Melbourne.

Clarke, K. R. and Warwick, R. M. (1994). *Change in Marine Communities: an approach to statistical analysis and interpretation.* Natural Environment Research Council, Plymouth, United Kingdom.

Department of Conservation, Forests and Lands. (1987). Victoria's Rainforests: an overview. Victoria, Australia.

Department of Natural Resources and Environment. (1996). Otway National Park management plan. Department of Natural Resources and Environment (National Parks Service), Victoria.

Filson, R. B. (1996). *Checklist of Australian Lichens and Allied Fungi.* Australian Biological Resources Study, Canberra.

Flora of Australia. (1992). *Flora of Australia Volume 54, Lichens – Introduction, Lecanorales 1.* Australian Government Publishing Service, Canberra.

Flora of Australia. (1994). *Flora of Australia Volume 55, Lichens – Lecanorales 2, Parmeliaceae.* Australian Biological Resources Study, Canberra.

Floyd, A.G. (1989). *Rainforest trees of mainland south-eastern Australia.* Inkata Press, Melbourne.

Ford, S. E. and May, T. (1998). *A cryptogamic extravaganza. Report of the FNCV expedition, 22–25 May, 1998, to commemorate the centenary of Wilsons Promontory National Park.* Field Naturalists Club of Victoria.

Griffin, M. and Conran, J. G. (1994). Ecology of the corticolous lichens on *Pinus radiata* at five sites of increasing age near Linton, Victoria, Australia. *Australian Journal of Ecology* **19**: 328–335.

Jarman, S. J. and Kantvilas, G. (1994). Lichens and bryophytes of the Tasmanian world heritage area II - Three forest sites at Pelion Plains. *Tasforests* **6**: 102–120.

Jarman, S. J. and Kantvilas, G. (1995a). *A Floristic Study of Rainforest Bryophytes and Lichens in Tasmania's Myrtle-Beech Alliance.* Tasmanian NRCP Report No. 14. Forestry Tasmania and Department of the Environment, Sport and Territories, Canberra, Australia.

Jarman, S. J. and Kantvilas, G. (1995b). Epiphytes on an old Huon pine tree (*Lagarostrobos franklinii*) in Tasmanian rainforest. *New Zealand Journal of Botany* **33**: 65–78.

Jarman, S.J., Kantvilas, G. and Brown, M.J. (1991). *Floristic and ecological studies in Tasmanian rainforest.* Tasmanian NRCP Report No. 3. Forestry Commission, Tasmania, and Department of the Arts, Sport, the Environment, Tourism and Territories, Canberra, Australia.

Kantvilas, G. (1990). Succession in rainforest lichens. *Tasforests* **2**: 167–171.

Kantvilas, G. (1995). A revised key and checklist for the macrolichens in Tasmanian cool temperate rainforest. *Tasforests* **7**: 93–127.

Kantvilas, G. and James, P. W. (1991). Records of crustose lichens from Tasmanian rainforest. *Mycotaxon* **41**: 271–286.

Kantvilas, G. and Jarman, S. J. (1991). Lichens and bryophytes of the Tasmanian world heritage area I - Mt. Sprent. In Banks, M. R., Smith, S. J., Orchard, A. E. and Kantvilas, G., eds. *Aspects of Tasmanian Botany - A Tribute to Winifred Curtis.* Royal Society of Tasmania. Hobart. pp. 149–162.

Kantvilas, G. and Jarman, S. J. (1993). The cryptogamic flora of an isolated rainforest fragment in Tasmania. *Botanical Journal of the Linnean Society* **111**: 211–228.

Louwhoff, S. (1992). *Lichens of Mt. Donna Buang (Preliminary Report).* Unpublished Master of Applied Science. Biological and Chemical Sciences, Deakin University. Melbourne, Australia.

Louwhoff, S. (1995). *The Lichen Flora of Mt. Donna Buang Scenic Reserve, Victoria.* Unpublished Master of Applied Science. Biological and Chemical Sciences, Deakin University. Melbourne, Australia.

Peel, B. (1999). *Rainforests and cool temperate mixed forests of Victoria.* Department of Natural Resources and Environment, Melbourne.

Stevens, G. N. (1999). A revision of the lichen family Usneaceae in Australia. *Bibliotheca Lichenologica* **72**: 1–128.

Wedin, M. (1995). The lichen family Sphaerophoraceae (Caliciales, Ascomycotina) in temperate areas of the southern hemisphere. *Symbolae Botanicae Upsalienses* **31**: 1–102.

Appendix 1. Lichen species list for the Otway Ranges, Victoria. Presence in two forest types - *Nothofagus*-dominated rainforests and *Acacia*-dominated forests.

Species List	***Nothofagus* rainforest**	***Acacia* forest**
Arthothelium interveniens (Nyl.) Zahlbr.	+	
Bacidia buchananii (Stirt.) Hellb.	+	+
Bacidia laurocerasi (Delise ex Duby) Zahlbr. [N]		+
Buellia sp. 1	+	
Buellia sp. 2	+	+
Bunodophoron australe (Laurer) A. Massal.	+	
Bunodophoron insigne (Laurer) Wedin	+	+
Bunodophoron murrayi (Ohlsson) Wedin [N]	+	+
Bunodophoron patagonicum (C.W. Dodge) Wedin	+	
Bunodophoron ramuliferum (I.M. Lamb) Wedin	+	
Bunodophoron sp.		+
Caloplaca sp.	+	
Chrysothrix candelaris (L.) J.R. Laundon	+	
Cladia aggregata (Sw.) Nyl.	+	+

Cladonia ochrochlora Florke	+	
Cladonia ramulosa (With.) J.R. Laundon	+	
Cladonia rigida (Hook f. & Taylor) Hampe	+	
Cladonia subradiata (Vain.) Sandst.		+
Cliostomum griffithii (Sm.) Coppins [N]	+	+
Coccotrema cucurbitula (Mont.) Mull. Arg. [N]	+	
Coenogonium implexum Nyl.	+	+
Collema fasciculare (?var. *microcarpum*) (Mull. Arg.) Degel.		+
Collema cf. *laeve* Hook f. & Taylor		+
Collema subconveniens Nyl.	+	+
Degelia gayana (Mont.) Arv. & D.J. Galloway		+
Dimerella lutea (Dicks.) Trevis	+	+
Graphis insidiosa (C. Knight & Mitt.) Hook. f. [N]	+	
Graphis tenella Ach.	+	+
Heterodermia hypocaesia (Yasuda) Awasthi		+
Hypogymnia enteromorphoides Elix		+
Hypogymnia mundata (Nyl.) Oxner ex Rass.	+	+
Hypogymnia subphysodes (Kremp.) Filson	+	
Hypogymnia (cf. *tasmanica*?)	+	
Hypotrachyna sinuosa (Sm.) Hale	+	
Lecanactis abietina (Ach.) Korb.	+	
Lecidea immarginata R. Br. ex Cromb. [N]	+	
Lefidium tenerum (Laurer) Wedin	+	
Lepraria lobificans Nyl. [N]	+	+
Lepraria sp.	+	+
Leptogium victorianum F. Wilson	+	+
Maronea constans (Nyl.) Hepp.	+	+
Megalaria grossa (Pers. ex . Nyl.) Hafellner	+	+
Menegazzia confusa P. James	+	+
Menegazzia eperforata P.James & D.J.Galloway [N]	+	
Menegazzia myriotrema (Mull. Arg.) R. Sant.	+	+
Menegazzia norstictica P. James	+	
Menegazzia platytrema (Mull. Arg.) R. Sant.	+	+
Menegazzia sp. 1	+	
Menegazzia subpertusa P. James & D.J. Galloway		+
Metus conglomeratus (F. Wilson) D.J. Galloway & P. James	+	
Micarea prasina Fr. [N]	+	+
Micarea spp. agg.	+	
Nephroma australe A. Rich	+	
Normandina pulchella (Borrer) Nyl.	+	+
Ochrolechia sp.	+	
Parmelia cunninghamii Cromb.	+	
Parmelia protosulcata Hale [N]	+	+
Parmelia tenuirima Hook. f. & Taylor	+	+
Parmeliella nigrocincta (Mont.) Mull. Arg.		+
Parmelina endoleuca (Taylor) Hale	+	
Parmelina labrosa (Zahlbr.) Elix & J.Johnst.	+	+
Parmelina quercina (Willd.) Hale	+	+
Parmelinopsis afrorevoluta (Krog & Swinscow) Elix & Hale	+	+
Parmelinopsis subfatiscens (Kurok.) Elix & Hale	+	+
Parmotrema chinense (Osbeck) Hale & Ahti	+	+
Parmotrema robustum (Degel.) Hale [N]	+	
Peltigera dolichorrhiza (Nyl.) Nyl.	+	+

Pertusaria gibberosa Mull. Arg.	+	+
Pertusaria novaezelandiae Szatala	+	+
Pertusaria truncata Kremp.	+	
Pertusaria sp. 1	+	+
Pertusaria sp. 2	+	
Phaeographis exaltata (Mont. & v.d. Bosch) Mull. Arg.[N]	+	
Phlyctis subuncinata Stirton [N]	+	+
Physcia adscendens (Fr.) H. Olivier		+
Pseudocyphellaria billardierei (Delise) Rasanen	+	
Pseudocyphellaria colensoi (C. Bab. ex Hook. f.) Vain.	+	
Pseudocyphellaria dissimilis (Nyl.) D.J. Galloway & P. James	+	+
Pseudocyphellaria glabra (Hook. f. & Taylor) C.W. Dodge	+	+
Pseudocyphellaria multifida (Nyl.) D.J. Galloway & P. James	+	+
Pseudocyphellaria rubella (Hook. f. & Taylor) D.J. Galloway & P. James	+	
Pseudocyphellaria sp. A	+	
Psoroma asperellum Nyl.	+	
Psoroma durietzii P. James & Henssen	+	
Psoroma leprolomum (Nyl.) Rasanen	+	+
Psoroma microphyllizans (Nyl.) D.J. Galloway	+	+
Psoroma sp. 1	+	
Punctelia borreri (Sm.) Krog		+
Pyrenula nitida (Weig.) Ach.	+	
Pyrenula sp. 1	+	+
Pyrrhospora laeta (Stirt.) Hafellner	+	+
Ramalina inflata Hook. f. & Taylor		+
Ramboldia brunneocarpa Kantvilas & Elix	+	
Rimelia reticulata (Taylor) Hale & A.Fletcher	+	
Sarrameana albidoplumbea (Hook.f. & Taylor) Farkas [N]	+	+
Sarrameana tasmanica Vezda & Kantvilas	+	+
Tephromela atra (Huds.) Hafellner	+	+
Thelotrema decorticans Mull. Arg.	+	
Thelotrema lepadinum (Ach.) Ach.	+	+
Thelotrema subdenticulatum (Zahlbr.) G. Salisb.	+	+
Thelotrema sp. 1		+
Thelotrema sp. 2	+	+
Usnea oncodeoides G.N. Stevens	+	+
Usnea oncodes Stirton [N]	+	+
Usnea ca. *punctulata* G.N. Stevens		+
Usnea pycnoclada Vainio [N]		+
Usnea rubicunda (Stirton) var. *spilota* (Stirton) G.N. Stevens	+	+
Usnea scabrida subsp. *tayloriana* G.N. Stevens	+	
Usnea subeciliata (Motyka) Swinscow & Krog	+	+
Usnea xanthopoga Nyl. [N]		+
Total Species: 110 ([N]17)	**93**	**67**

[N] = Newly Recorded for Victoria
50 species common to both forest types